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Military Technology Trends

Here is another in a series of up-to-date reports on trends in military technology and procurement based on official comments.

- * Navy Air Defense: Concern is expressed over the "disproportionate share" of national resources which might be placed on programs for the defense of the fleet against air attack. This includes naval interceptors, air-to-air missiles, surface-to-air missiles and a variety of electronic detection, control and communication equipment. It is stated that the cost of such systems might easily rise to a level of \$1.5 to \$2 billion annually which is considered excessive "considering the relatively small size of the striking force they are intended to protect."
- * Mine Countermeasures: The Defense Department is stressing means of increasing the efficiency and speed of mine countermeasures, while making it safer for the men who do the job. Programs include the development of helicopters for minesweeping operations and high resolution sonars for minehunting.
- * Missile Mobility: The Defense Department is now looking at plans to place the Navy's Polaris missile on trucks for land mobility. Plans are well underway to place the Army's Pershing missile aboard the M-113 armored personnel carrier for cross-country mobility.
- * Hercules Radar: A radar frequency diversity program in connection with the Nike-Hercules antiaircraft missile program is designed to give the Hercules a choice of frequencies and a capability for moving from one to another rapidly to prevent enemy jamming.
- * Bomarc Difficulties: The difficulties experienced by the Air Force with its Bomarc antiaircraft missile program are attributed largely to ground equipment. It is believed that equipment was installed incorrectly when testing was moved from Cape Canaveral to Eglin Air Force Base, Fla., and that following the move the equipment was not compatible with certain minor changes that were made.
- * IR Warning: During 1961 the Air Force expects to develop an infrared warning receiver to be used by the Strategic and Tactical Air Commands to detect increases in infrared sources in sufficient time to permit necessary and adequate countermeasures.

- * Aeroballistic Missiles: Attention is being given to the use of so-called aeroballistic missiles as a means of increasing payload and accuracy without increasing rocket size. The payloads in question would be lifted to altitudes of only 100,000 or 150,000 feet at speeds of mach 15, compared to the strictly ballistic, mach 25 performance of current ICBMs. The lift-glide principle would be employed, with the possibility of installing a terminal guidance system for increased accuracy. This system might be employed to provide special new payloads for existing boosters.
- * Quarpel: Fabric treated with an oil and water repellent referred to as Quarpel is to be used for the outer shell of the Army field uniform. The combination of fabric and finish has resisted penetration by rainfall at the rate of 1 inch per hour for 7 days. Tests have shown that moisture and air permeability is not adversely affected. Development is continuing to provide protection against flame and chemical and biological agents.
- * Hydrofoil: Dr. Herbert York, Director of Defense Research and Engineering has informed the Navy that funds can be provided for hydrofoil craft up to 350 tons for antisubmarine warfare applications. This would be in addition to a 110-ton hydrofoil with variable depth sonar already being considered. Dr. York has also inquired as to whether the U.S. Navy would be interested in backing a Canadian 200-ton hydrofoil.
- * ASW Proposals: Over the period January 1, 1958 to December 31, 1959 the Navy received 534 proposals in the antisubmarine warfare field, including about 100 without any cost information or simply "ideas." There were an additional 48 proposals at no cost to the Government. Of these privately financed suggestions 24 have been accepted, 7 are pending and 17 have been rejected. The total number of proposals accepted over this period comes to 155. There are 214 still pending. Approximate funding was \$26 million.
- * ASW Developments: The Navy is currently testing a new magnetometer which is expected to have important advantages in the classification of possible targets at sea. Also "coming along well" is Jezebel, a passive buoy used for fixing the position of noisy submarines, and Julie, a buoy that uses an explosive sound source for echo ranging.
- * Torpedoes: The Navy hopes to have its Mark 46 solid-propellant burning torpedo available for operation in the fleet in 1963. This is a light-weight high-speed homing antisubmarine torpedo in which gases from the propellant drive the turbines. A related program is Retorc II, a research program for advanced torpedo design.
- * Reconnaissance Film: New materials and techniques that will replace the conventional photographic silver bromide film is being sought by the Air Force for satellite reconnaissance purposes. The requirements include a process that will not be affected by nuclear radiation; will be easily processed; will have good sensitivity and resolution; and will be reusable. This program will continue to include investigations of light sensitive dyes that have reversible properties; materials with photoelectron emission characteristics and materials which deform when exposed to light.

- * Aerial Crane Concept: The Army expresses continued interest in the design of a large external-lift type helicopter or "flying crane" which could carry payloads of up to 12 tons for distances of 20 miles. Previous studies indicate that the use of rotor blade tip propulsion would be far superior for this purpose to systems utilizing conventional shaft and gear drive to the rotor hub. As a result the Army is sponsoring further development of tip propulsion systems in order to solve the aerodynamic and mechanical problems involved. The Army has also looked at various plans by which several helicopters carry a frame from which heavy loads could be suspended but does not believe that this concept warrants further development. The Army also states that it is not interested in another helicopter under development as a "flying crane" model since it can lift only "slightly more" than the eight tons to be carried by its new Chinook helicopter.

- * Improved Army Rifle: The Army hopes that by 1965 it can develop a rifle and 750 rounds of ammunition that will be no more of a burden to the soldier than the present M-14 and 160 rounds of ammunition. A new cartridge, details of which are classified, is under development. Then the Army intends to build a rifle around that, "as small and as simple as we can."

- * Hawk Missile System: The Army is not planning to build a so-called "second generation" of its Hawk surface-to-air missile system because ... "certain developments in the state of the art leads us to believe that there may be possibilities of accomplishing something better." These other possibilities are currently being analyzed.

- * Davy Crockett: The Army intends to procure both a light and heavy version of its Davy Crockett missile system. One version will be man-portable to be used in forward areas at short ranges. The heavier version is planned to have a greater range capability. Both versions are intended to provide tactical nuclear support.

- * Body Armor Research: The Army is testing a new composite armored vest of titanium plates and nylon fabric which is expected to provide a significant increase in protection against modern ammunition without weight penalty. New alloys of magnesium, aluminum, titanium, various ceramics, plastics and fabrics are also being tested. A remaining problem is the development of eye armor that will be transparent and optically satisfactory. An armor device that will protect the eyes from the dazzle of a nuclear blast is also being sought. Another unsolved problem is an effective, lightweight means of protecting the feet and lower limbs from antipersonnel mines.

- * Columbium: The Navy believes it has achieved an important milestone in the use of coatings for Columbium, a practical metal for strength at temperatures in the 1,800 to 2,500°F. range which oxidizes within minutes. Studies at the Naval Research Laboratory show that an ordinary zinc coating creates a protecting layer of complex zinc-columbium oxide. This layer has been found to be "self-healing" -- when flows or strains break the coating it tends to reform even when temperatures run up to 2,200°F. for considerable periods of time.

Project Wagmight

An official Navy report recommending immediate design, construction and flight test of a Wagmight missile/aircraft has been released by the House Military Appropriations Subcommittee over the opposition of the Navy's research chief. Details of this unique inflatable weapon were first reported exclusively in Washington SCIENCE TRENDS, Dec. 14, 1959.

Wagmight Study Report, submitted during secret testimony by Capt. Cooper B. Bright of the Office of the Deputy Chief of Naval Operations confirms all details of the SCIENCE TRENDS report and states, in part:

* Wagmight would be "capable of low altitude tactical missions at high subsonic speeds. It has a wingspan of 20.9 feet, overall length of 39 feet, height of 11.2 feet and weighs 15,500 pounds."

* Wagmight, in one configuration "is a monoplane having two jet engines delivering a maximum speed of about 480 miles per hour at sea level. It is designed for a 110 mph landing and has a 1,100 mile range."

"Aerodynamic shape of the wings, fuselage and empennage (tail structure) is maintained by being inflated with 50 pounds of air pressure. The metal engine, instruments, landing wheels and the plastic or metal cockpit section are the only rigid parts. This inflatable aircraft is ideal for naval use, as it can operate from land, ships or from the water as a seaplane."

* Operational studies by the Navy demonstrate that one thousand such missile/aircraft could be packaged and accommodated aboard a Navy aircraft carrier such as the Forrestal, which now carries 80 to 90 aircraft. The Wagmight estimate is based on the utilization of 50 percent of available hanger deck space. Other studies indicate that present amphibious ships such as the Thetis Bay could carry 145 Wagmights using half available space, while submarines could carry up to 60. Operating a minimum of five Wagmights from available destroyers is also recommended.

Study, as released by the Subcommittee April 15, concludes that the technical feasibility of the Wagmight concept "has been established" and that program approval could lead to a "revolutionary advance" in Naval technology and defense preparedness. In related testimony Vice Adm. John T. Hayward said he did not agree that "all technical problems have been solved" at the present time.

The subcommittee was told that the Wagmight system originated as the result of studies within the office of the Chief of Naval Operations and that "the U.S. Government is the sole owner of whatever this Wagmight may ultimately be."

The Subcommittee is one of four Congressional groups which have studied the program since the SCIENCE TRENDS report. Others are the House Committee on Science and Astronautics and the Senate Committees on Appropriations and Armed Services.

NASA Materials Research

Here is a summary of some major programs in the field of materials research by or for the National Aeronautics and Space Administration:

- * Fiber Metallurgy: Fine wires are being used at the NASA Lewis Research center in studies aimed at possible means of increasing the strength of metals without increasing weight.

Fundamental studies using tungsten wires embedded in copper have demonstrated that copper, with a strength of 30,000 pounds per square inch, can be strengthened to more than 120,000 pounds by adding 35 volume percent of tungsten fibers. NASA believes this demonstrates that it is possible to strengthen relatively weak metal by simply adding a stronger fiber to the metal.

- * Materials for Cryogenic Fuel Storage: NASA is looking into the design of reliable tanks of minimum weight for extremely low-temperature space vehicle fuels.

Tests are being made on sheet metal specimens at liquid hydrogen temperatures. And, to determine how well tensile properties can be used to predict material performance in fuel tanks, a program is underway to test and compare the performance of small-scale pressure vessels filled with liquid hydrogen. Emphasis is on materials that are relatively insensitive to notches at low temperatures -- austenitic stainless steel and aluminum, nickel and titanium based alloys.

- * Cryogenic Tank Insulation: Maintaining liquid hydrogen temperatures during atmospheric portions of space flight is being studied at NASA Laboratories. Insulation types under study are non-vacuum, non-metallic, bonded to the outside of the tank and surfaced-sealed against air penetration into the insulation.

Results indicate:

- # Best of the materials studied are corkboard, and insulation-filled glass-cloth honeycomb having continuous-surface layers on both faces -- sandwich construction.
- # Epoxy resin fiberglass can be used to bond the insulation to the cryogenic propellant tank.
- # Corkboard has the lowest overall thermal conductivity of all the materials studied -- about 40 percent below the best insulation-filled sandwich materials.
- # Mylar sheet -- 0.001-inch thick -- can be bonded to the insulation for an effective seal of the external surface.
- * High-Temperature Bearings: NASA studies indicate that gas-lubricated bearings are among the most promising types of bearings for high-temperature applications, although the requirement of continual pressurized gas supply might be detrimental on long-term space flights. For short flight time, vehicles employing rocket engines in which exhaust gases are available might prove satisfactory. It is reported that problems which must be solved before these bearings can be used successfully at high temperatures include inherent instability and ability to function when distorted.

Air Force Development Groups

U.S. Air Force, for the first time, has detailed its support contract programs with major non-profit organizations established for technical assistance. These groups will receive an estimated \$99 million in the Fiscal Year beginning July 1, 1960.

* Rand Corporation - \$13.5 million to continue its program of scientific research and study on the broad subject of air warfare.

* Lincoln Laboratories - Some \$21 million is programmed for Lincoln Laboratories to cover its efforts in general research toward discovering new technical concepts which are applicable to national defense. Work will be continued in areas of solid state, information-processing, communications, radar and systems research.

* Mitre Corp. - This subsidiary of the Massachusetts Institute of Technology has been engaged to aid the Air Force in the solution of complex problems related to the electronic area. The \$20 million programmed will cover the cost of the Mitre contract. In addition to the operation of an experimental SAGE (Semi-Automatic Ground Environment) sector, Mitre provides engineering support and technical advice in the effort to integrate air defense weapons and the associated ground environment.

* Space Technology Laboratories - This organization will receive \$44 million, primarily to pay the salaries of scientists and engineers engaged by the Air Force to assist in the ballistic missile program. STL has the responsibility for the systems engineering associated with ballistic missiles, evaluating contractor proposals and making sure that subsystems are compatible. The Air Force states that STL does a "small amount" of applied research work aimed at general improvement of the program.

* Analytic Services, Inc. - This organization, also known as Anser, is a study group operating directly in support of Headquarters, U.S.A.F. for the purpose of assisting in the quick evaluation of development planning problems. This organization located in Alexandria, Va., will operate under a \$1 million contract during Fiscal, 1961. Last year, according to the Air Force, this organization was able to establish the origin of reports that the Soviets had developed a means for controlling balled lightning. From its findings the Air Force concluded that there was no basis for such a report.

Automatic Air Traffic Control

Mitre Corp. (see above) received a \$5,974,500 contract this week for advanced experimentation on automatic air traffic control. Work is to include the design and testing of a semiautomatic air traffic en-route control system using available air defense SAGE facilities. Federal Aviation Agency made the award.

In another phase of its expanding research program, the FAA has opened a new computer laboratory at its Atlantic City, N.J. experimental center. A Remington Rand Univac File-1 computer and auxiliary devices similar to those being installed at air traffic controls in various parts of the U.S. will be employed.

R&D Checklist

- () Lens Design: National Bureau of Standards has developed a new method for solution of lens design problems. The system permits the designer to define the total aberrations of a lens system in terms of algebraic matrices. This is said to eliminate one of the greatest stumbling blocks to the designer -- the correlation of aberrations with such parameters as the curvatures, separations and thicknesses of the lenses and the indices of refraction.

(Details available. Single copies free. Write National Bureau of Standards, Office of Technical Information, Washington 25, D.C., for Summary Technical Report - Matrix Algebra for Lens Designs)

- () Plastic Helmet Liner: The Army has hopes of perfecting a new ballistic-resistant helmet liner for combat soldiers as a replacement of cotton fabric liners used for a number of years. A process has been developed for the coating of basketweave nylon fabric in which a single modified catalyzed resin blend is employed in a "quick cure" cycle to reduce time and cost. The blend consists of polyvinyl butyral, phthallic anhydride and phenol formaldehyde with trimethylol phenol as a catalyst.

(R&D by A.L. Alesi and M.E. Landsberg, Plastics Division, Army Quartermaster Research and Engineering Command, Natick, Mass.)

- () Geodetic Survey System: The U.S. Air Force plans development of a long-range (1500 mile) electronic geodetic survey system to measure azimuth within a few hundred feet at the maximum range. This contrasts with present equipment, which is said to have a maximum range of about 250 miles. The new equipment is expected to provide an improved capability to do aerial mapping and charting from extended distances.

- () Radioisotope Symposium: Atomic Energy Commission and Purdue University will sponsor a two-day Symposium on the Uses of Radioisotopes in the Pharmaceutical Industry at Lafayette, Ind. April 25-26, 1960. Radioisotope applications in drug structure, testing and process control as well as laboratory design, recent advances and other facets will be discussed.

(Management and Technical Personnel and Educators wishing to attend may contact Dr. John E. Christian, Head, Bionucleonics Dept., Purdue University, Lafayette, Ind.)

- () Electrical-Discharge Machining: Studies at the Army's Rock Island Arsenal indicate that electrical-discharge machining can be applied to any conductive metal, regardless of hardness or shape. Tests were conducted to find a means of machining normally hard-to-cut steels and carbides.

(Report of June, 1959 now available. 35 pages. \$1. Write OTS U.S. Department of Commerce, Washington 25, D.C. for PB 161 267)

Publication Checklist

- () Electron Tubes, A Defense Department Directory, published in 1959 and now available, which provides a generally complete list of electron tube types used in armed services equipment or stocked in depots. Also included is a cross reference to any other type numbers or designations these tubes may have -- to serve as an interchangeability guide. 230 pages. \$1.50. (Write Superintendent of Documents, Government Printing Office, Washington 25, D.C. for Pub. No. D 7.6/2:213)
- () AEC Annual Report, the yearly summary by the Atomic Energy Commission on major activities in atomic energy programs during 1959, including special material on the handling of radioactive wastes. 628 pages. \$2. (Write Superintendent of Documents, Government Printing Office, Washington 25, D.C. for Pub. No. Y3 At 7:2 P94/2/959)
- () Electronegatives, a report providing revised electronegativity values for the more electropositive elements including the rare earth metals. 11 pages. Single copies free. (Write Publications-Distribution Section, U.S. Bureau of Mines, 4800 Forbes Avenue, Pittsburgh 13, Pa., for Report of Investigation No. 5567)
- () Food Irradiation, testimony, statements and exhibits relating to the Army program for the preservation of food through irradiation. 667 pages. Single copies free. (Write Joint Committee on Atomic Energy, F-88, The Capitol, Washington 25, D.C., for Hearings, National Food Irradiation Research Program, Part I)
- () Soviet Army, an interesting guide for anyone concerned with defense technology. This Defense Department handbook presents information on the Soviet military system, military doctrine, organization of the field forces, personnel and training, logistics, weapons, equipment, etc; Also gives information on the Soviet Navy and Air Force. 260 pages in looseleaf form. No binder provided. \$2. (Write Superintendent of Documents, Government Printing Office, Washington 25, D.C. for Pub. 18E, Soviet Army Handbook)
- () Magnetic Exploration of Upper Atmosphere, a compilation of data on this phase of investigations during the International Geophysical Year. 88 pages. \$1. (Write Printing and Publishing Office, National Academy of Sciences, 2101 Constitution Avenue, Washington 25, D.C. for IGY Rocket Report Series No. 4)
- () Precision Casting, a U.S. Government translation of a 1954 Soviet work now available. Describes the processes of precision casting and includes examples of the casting of heat-resistant alloys, casting quality, scrap control measures and related information. 143 pages. \$3. (Write OTS, U.S. Department of Commerce, Washington 25, for Translation 59-11937)
- () Electron Tubes Industry, a 1958 census report now available showing that manufacturers in this industry shipped products valued at \$1,105 million during the year -- a 53 percent increase over 1954. Includes other statistical and marketing information. 4 pages. 10 cents. (Available from Publications Office, Bureau of the Census, Washington 25, D.C. or Field Offices, U.S. Department of Commerce. Ask for Census Report MC (p)-36C-2, April 1960)

